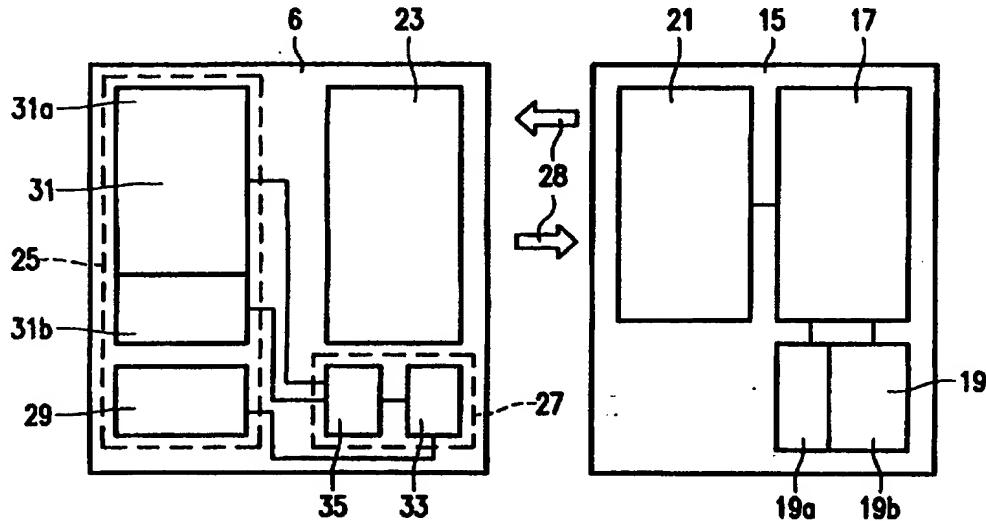




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(54) Title: PRINTING DEVICE**(57) Abstract**

The device includes a printer (16) with a control unit (15), having a first electronic storage device (19), and a cartridge (6) for a printing medium which can be detachably connected to the printer. The cartridge (6) includes a second electronic storage device (25) which stores data concerning the cartridge. The printing device also includes communication means (21, 23) for the exchange of data between the printer (16) and the second storage device (25). The first storage device (19) stores a first code word and the second storage device (25) stores a second code word. A protection device (27), provided in the printing device, includes comparison means (33) for comparing the second code word with the first code word. Inhibit means (35) are arranged to enable cooperation between the printer (16) and the cartridge (6) only after correspondence between the second code word and the first code word has been detected by the comparison means (33).

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Printing device.

The invention relates to a printing device which includes a printer with a control unit, having a first electronic storage device, and a cartridge for a printing medium which can be detachably connected to the printer, the cartridge including a second electronic storage device in which data concerning the cartridge is stored, the printing device also 5 including communication means for the exchange of data between the printer and the second storage device.

A printing device of this kind is known from WO 90/00974. The storage 10 device in the known device can contain information concerning the quantity and the storage life of the printing medium present in the cartridge. It has been found that cartridges of this kind are often imitated, without authorization, by manufacturers other than the manufacturer of the printing device. This is detrimental on the one hand because the quality of the printing medium in the imitated cartridges is not guaranteed and on the other hand because the 15 manufacturer of the printing device thus misses out on the profits of the sale of the cartridges.

It is an object of the invention to provide a printing device of the kind set 20 forth in which the use of cartridges other than those approved by the manufacturer of the printing device can be inhibited. To this end, the printing device in accordance with the invention is characterized in that the first storage device stores a first code word and the second storage device stores a second code word, and that the printing device also includes a protection device with comparison means for comparing the second code word with the first 25 code word and with inhibit means which are arranged to enable cooperation between the printer and the cartridge only after the comparison means have detected that the second code word and the first code word form an authorized combination. The manufacturer of the printer can then store the first code word in the first storage device and a manufacturer of cartridges who does not know this first code word cannot produce cartridges capable of

cooperation with the relevant printer.

An embodiment of the printing device according to the invention is characterized in that the second storage device includes first storage means and second storage means, the second code word being stored in the first storage means. The first storage means may in that case be of a type in which information can be stored only once, for example an EPROM. The second storage means preferably consist of a non-volatile, writable memory in which the communication means can store given data during use of the cartridge.

A further version of the latter embodiment is characterized in that the protection device is arranged to enable the cooperation between the printer and the cartridge by enabling the exchange of data between the communication means and the second storage means. The printer recognizes the presence of the cartridge only if the second storage means are accessible to the communication means. Cooperation between the printer and the cartridge will be possible only after such recognition.

A manufacturer of cartridges could program its cartridges in such a manner that they present each time a different second code word to the printer in an attempt to try and find the correct code word. In order to prevent this, a further embodiment of the printing device according to the invention is characterized in that the protection device is arranged to inhibit the cooperation between the printer and the cartridge permanently after the comparison means have established a predetermined number of times in succession that a second code word does not correspond to the first code word.

A further embodiment of the printing device according to the invention is characterized in that the second storage means contain information concerning the quantity of printing medium present in the cartridge, and that the control unit is arranged to update this information on the basis of the quantity of printing medium consumed by the printer after installation of the cartridge in the printer. The device can thus inform the user when the quantity of printing medium in the cartridge has almost been used up, so that the cartridge can be replaced in time by a full cartridge. This embodiment can also be advantageously used if the printing device is, for example a postage meter. In that case the total amount of postage paid can be readily deduced from the information stored in the second storage means. Preferably, in such cases the control unit is also arranged to control the inhibit means in such a manner that they permanently inhibit the cooperation between the printer and the cartridge when the information stored in the second storage means indicates that the quantity of printing medium in the cartridge has dropped below a predetermined value.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

5 In the drawings:

Fig. 1 is a diagrammatic perspective view of an embodiment of a printing device according to the invention,

Fig. 2 shows a block diagram of a part of the device shown in Fig. 1,

Fig. 3 shows a flow chart illustrating the operation of the device shown in

10 Fig. 1,

Fig. 4 is a sectional view of a part of a cartridge for the device shown in Fig. 1, and

Fig. 5 is a front view of the cartridge shown in Fig. 4 and a front view of a surface of a printer associated with the printing device shown in Fig. 1, said surface 15 cooperating with said cartridge.

Fig. 1 is a diagrammatic view of a printing device which includes an ink jet printer. The device includes a printing head 1 with a substantially linear array of nozzles 20 for the ejection of droplets of ink. This array of nozzles, extending parallel to the dash-dot line 3, is not visible in Fig. 1. Opposite the nozzles there is arranged a standby and service station 5 for keeping the printing head 1 in the appropriate condition when the device is not in use. Also provided is a cartridge 6 which contains a printing medium, being ink in the present case. During operation the ink is supplied from the cartridge 6 to the printing head 1. 25 The device also includes transport means in the form of a pair of cooperating rollers which are driven by means of a motor 9. The rollers 7 serve to transport a record carrier 11, usually a sheet of paper, in such a manner that it moves between the printing head 1 and the standby and service station 5 in a direction transversely of the array of nozzles. The transport direction of the record carrier 11 is denoted by an arrow 13. During transport of the record 30 carrier 11 in this manner, one of its surfaces (the surface facing down in Fig. 1) faces the nozzles. A control unit 15 serves to control the device. The transport means 7, 9, the control unit 15, the service and standby station 5 and the printing head 1 together constitute a printer 16. The cartridge 6 can be added thereto as an exchangeable component. It is alternatively possible for the printing head 1 and the cartridge 6 to form a part which can be exchangeably

connected to the other parts of the printer 16. The printing device described thus far corresponds to known printing devices, see for example European Patent Application EP 755 790.

Fig. 2 shows a block diagram of a part of the printing device of Fig. 1; 5 this block diagram shows how the steps according to the invention can be implemented in this device. The control device 15 includes inter alia a processor 17, a first electronic storage device 19 and a first communication unit 21. The first storage device 19 includes a memory section 19a of the type in which information can be stored only once, for example a ROM or an EPROM, and a further memory section 19b which is preferably non-volatile and writable. 10 The cartridge 6 includes inter alia a second communication unit 23, a second storage device 25 and a protection device 27. When the cartridge 6 is attached to the printer 16, the first communication unit 21 is electrically connected to the second communication unit 23 as will be described hereinafter. The two communication units together constitute communication means for the exchange of data between the second storage device 25 and the control unit 15 15 present in the printer 16. The foregoing is symbolically denoted by the arrows 28. In the present embodiment the second storage device 25 includes first storage means 29 and second storage means 31. The first storage means 29 are formed by a memory of a type in which information can be stored only once, for example an EPROM. The second storage means 31 may include a non-volatile, writable memory 31a, possibly in combination with a memory 20 31b which can be written only once. The protection device 27 includes comparison means 33 and inhibit means 35.

During the manufacture of the printer 16 a first code word is stored in the non-writable section 19a of the first storage device 19. The first code word is known exclusively to the manufacturer of the printer 16. A second code word is stored in the first storage means 29 of the second storage device 25. After the cartridge 6 has been fitted on the printer 16, the protection device 27 is instructed by the processor 17, via the communication means 21, 23, to compare the second code word with the first code word. To this end, the two code words are written into the comparison means 33 which compare the contents of the two code words in known manner. If the comparison means 33 establish 25 correspondence between the second code word and the first code word, the inhibit means 35 enable access to the second storage means 31. As from that instant the processor 17 can 30 exchange information with the second storage means 31, via the communication means 21, 23.

The second storage means can store, for example information concerning

the quantity of printing medium present in the cartridge 6 (ink in the present embodiment). The processor 17 is preferably programmed in such a manner that when the information in the second storage means 31 indicates that the quantity of ink in the cartridge 6 has dropped below a predetermined minimum, the inhibit means 35 are controlled so that they

5 permanently inhibit the cooperation between the printer 16 and the cartridge 6. The printer 16 can operate only after a fresh, filled cartridge 6 has been fitted whose first storage means 29 contain the correct second code word. The control unit 15 is preferably arranged to update the information in the second storage means 31, continuously or intermittently, during operation of the printing device, on the basis of the quantity of ink consumed by the printer

10 16. The user of the printing device can thus be informed to replace the cartridge 6 by a fresh cartridge in time. If the user fails to do so, the control unit 15 will inhibit the operation of the printer 16. If the printing device is, for example a postage meter, the printing device can thus be inhibited after a given amount of postage has been printed. In such a case the user pays the postage via the price of the cartridge 6 and the device refuses further operation as

15 soon as the total amount of postage paid reaches the amount paid for the cartridge 6.

The described system, involving comparison of the two code words, prevents unauthorized manufacturers from successfully marketing cartridges for the printing device. However, it could nevertheless occur that such a manufacturer programs its cartridges in such a manner that, after rejection of a second code word, they present another

20 second code word and so on until by accident the correct second code word, corresponding to the first code word, is found. Even though this procedure will generally be very time consuming, and hence not very attractive to the user, it may still be desirable to prevent such practices. To this end, the protection device 27 is arranged to inhibit the cooperation between the printer 16 and the cartridge 6 permanently after the comparison means 33 have

25 established a predetermined number of times in succession that a second code word does not correspond to the first code word. This number is, for example three. This procedure is illustrated in the form of a flow chart in Fig. 3, in which the second code word is called "password".

The functional elements shown in the block diagram of Fig. 2 may be

30 accommodated together in a single integrated circuit (IC). Such circuits are known per se, for example as "security chips". Fig. 4 shows how such an IC can be attached to the cartridge 6. The Figure shows a part of a wall of the cartridge 6 in which there is formed a recess 37, a first part of which, situated at the outer surface of the wall, has transverse dimensions larger than those of its second part which is situated further inwards. The

transverse dimensions of the first part are, for example 10 mm x 10 mm with a depth of approximately 1 mm. The transverse dimensions of the second part are then approximately 9.5 mm x 9.5 mm with a depth of approximately 3 mm. The first part is filled substantially completely with a support 39 of an electrically insulating material, for example a synthetic material, on which the security chip 41 is mounted. The support 39 is provided with a number of openings 43 offering access to metallized parts 45 on the outwards facing side of the support. The metallized parts serve as contact pads. Via bond wires 47, they are electrically conductively connected, in known manner, to conductive surfaces on the security chip 41, after which the assembly is encapsulated with a so-called glob-top 49 for protection purposes.

Fig. 5A is a plan view at a reduced scale of the wall of the cartridge 6 shown in Fig. 4. The Figure shows the support 39 with the contact pads 45. The wall shown is also provided with a connection 51 for the passage of ink.

Fig. 5B shows a part of a wall of the printing head 1 on which the cartridge 6 can be mounted. This part is provided with contact pads 53 whose size and relative position correspond to the size and the relative position of the contact pads 45 of the cartridge 6. The wall part shown also includes a connection 55 which is arranged to cooperate with the connection 51 of the cartridge 6. In the present embodiment the printing head 1 includes a part of the control unit 15, for example the first communication unit 21 and the non-writable section 19a of the first storage device 19. Via connection means (not shown), this part of the control unit 15 is connected to the remainder of the control unit, such as the processor 17 and the further section 19b of the first storage device 19, which are accommodated in the housing of the printer 16. This configuration offers the advantage that the first code word is present within the printing head 1 so that it can be entered by the manufacturer of the printing head. Consequently, it is not necessary to make the first code word known to the manufacturer of the printer which is not always the same as the manufacturer of the printing head. The latter benefits the most from the protection, because the printing head and the ink must be very accurately matched. Generally speaking, the further parts of the printer 16, for example the transport means 7, 9, operate independently of the type of ink in the cartridge 6. A manufacturer which purchases the printing head and manufactures the other parts of the printer, therefore, has less interest in the protection and need not know the first code word. However, from a technical point of view it is equally well possible to accommodate the entire control unit 15 in the housing of the printer 16. This approach may be adopted, for example if the cartridge 6 is not mounted on the printing head

1, as in the example shown in Fig. 1, but somewhere else on or in the housing of the printer 16. In that case the printing head 1 generally is connected to the cartridge 6 via a flexible ink duct. Evidently, the contact pads 53 must then be situated on the housing of the printer 16 at an area intended to receive the cartridge.

5

The invention has been described on the basis of an ink jet printer for which it is particularly suitable indeed. However, the invention is also suitable for other types of printing devices, such as thermal printers, laser printers, etc.

CLAIMS:

1. A printing device which includes a printer (16) with a control unit (15), having a first electronic storage device (19), and a cartridge (6) for a printing medium which can be detachably connected to the printer, the cartridge including a second electronic storage device (25) in which data concerning the cartridge is stored, the printing device also including communication means (21, 23) for the exchange of data between the printer and the second storage device, characterized in that the first storage device (19) stores a first code word and the second storage device (25) stores a second code word, and that the printing device also includes a protection device (27) with comparison means (33) for comparing the second code word with the first code word and with inhibit means (35) which are arranged to enable cooperation between the printer (16) and the cartridge (6) only after the comparison means have detected that the second code word and the first code word form an authorized combination.
2. A printing device as claimed in Claim 1, characterized in that the second storage device (25) includes first storage means (29) and second storage means (31), the second code word being stored in the first storage means.
3. A printing device as claimed in Claim 2, characterized in that the protection device (27) is arranged to enable the cooperation between the printer (16) and the cartridge (6) by enabling the exchange of data between the communication means (21, 23) and the second storage means (31).
4. A printing device as claimed in any one of the preceding Claims, characterized in that the protection device (27) is arranged to inhibit the cooperation between the printer (16) and the cartridge (6) permanently after the comparison means (33) have established a predetermined number of times in succession that a second code word does not correspond to the first code word.
5. A printing device as claimed in any one of the Claims 2 to 4, characterized in that the second storage means (31) contain information concerning the quantity of printing medium present in the cartridge (6), and that the control unit (15) is arranged to update this information on the basis of the quantity of printing medium consumed by the printer after installation of the cartridge in the printer (16).

6. A printing device as claimed in Claim 5, characterized in that the control unit (15) is also arranged to control the inhibit means (35) in such a manner that they permanently inhibit the cooperation between the printer (16) and the cartridge when the information stored in the second storage means (31) indicates that the quantity of printing medium in the cartridge (6) has dropped below a predetermined value.

5 7. A printing device as claimed in any one of the preceding Claims, in which the printer (16) is an ink jet printer provided with a printing head (1), the cartridge (6) being an ink cartridge, characterized in that at least a part of the control unit (15) is accommodated in the printing head (1).

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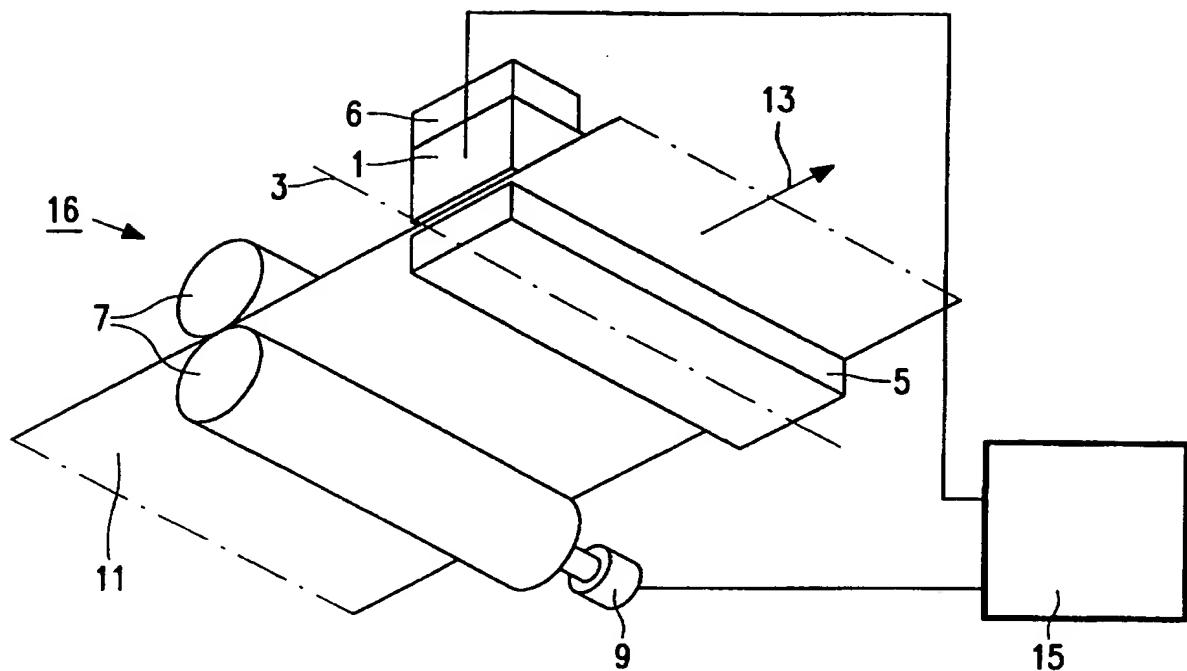


FIG. 1

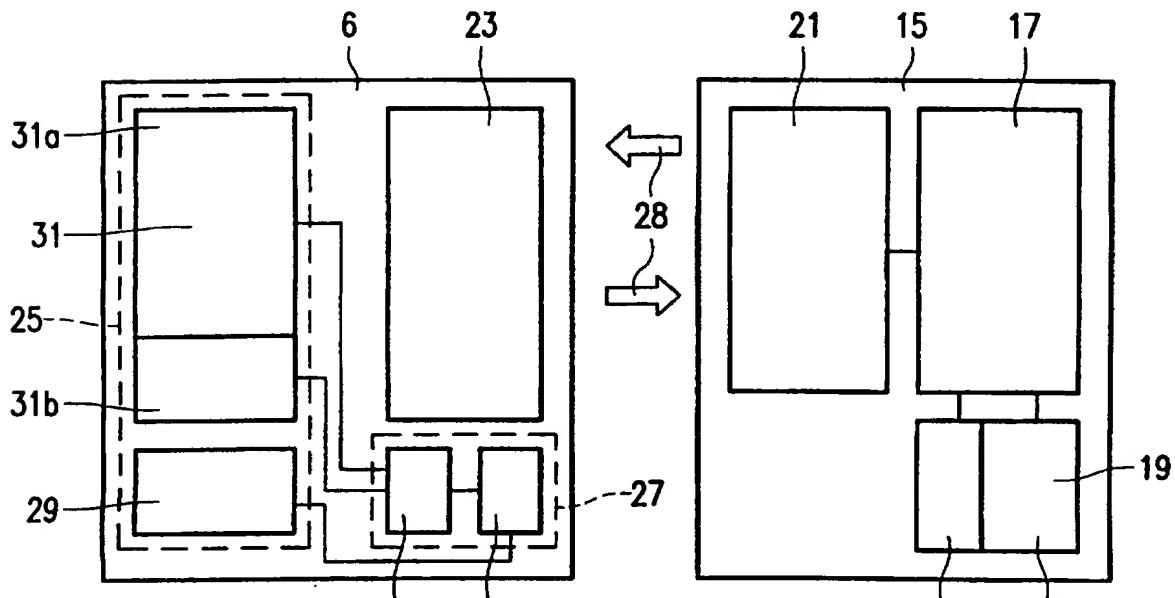


FIG. 2

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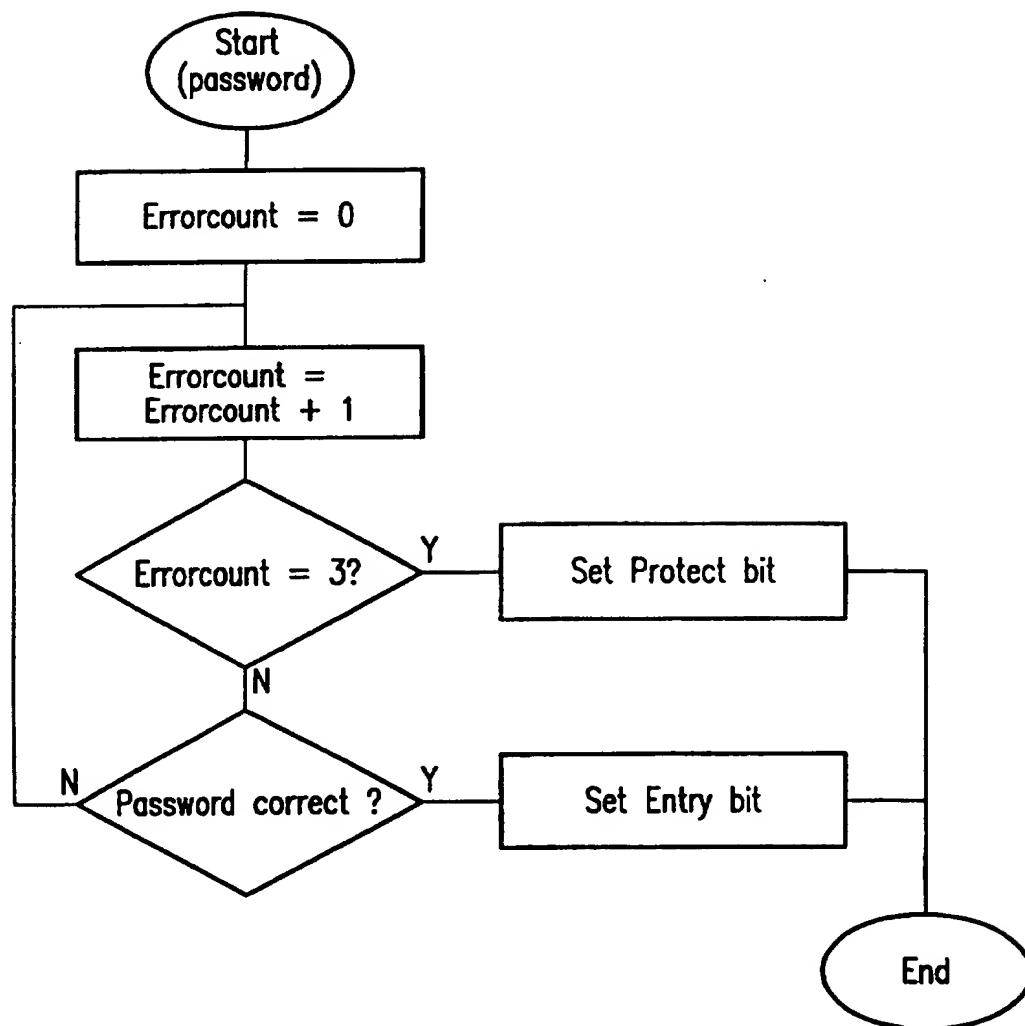


FIG. 3

3/3

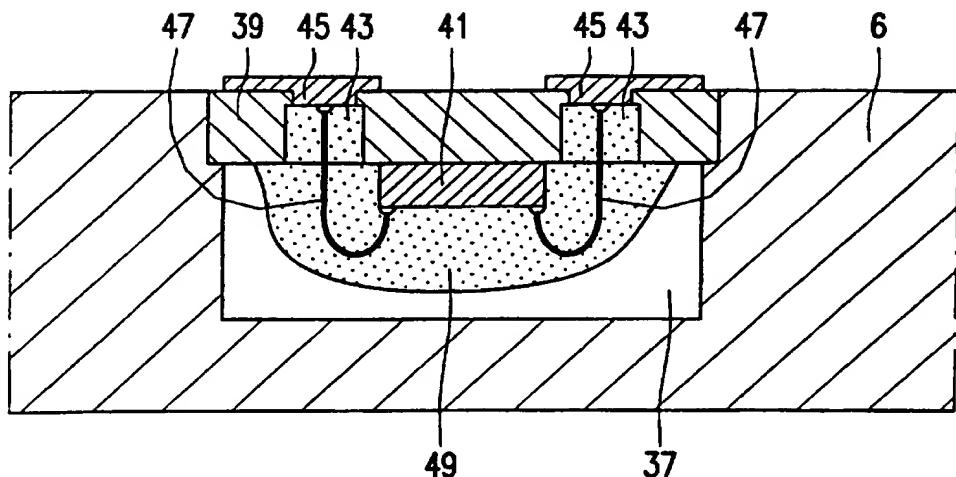


FIG. 4

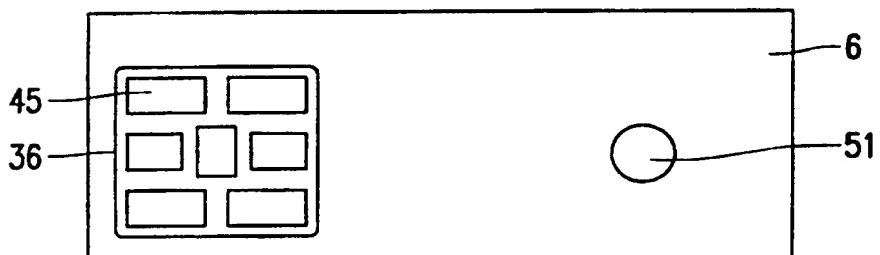


FIG. 5A

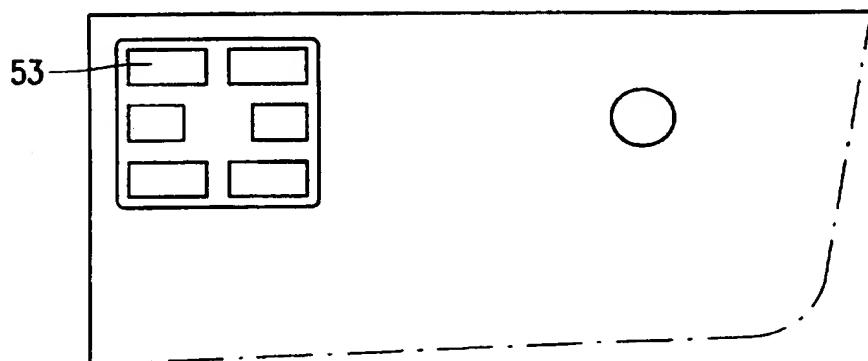


FIG. 5B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 97/00706

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B41J 2/17

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9000974 A1 (SIEMENS AKTIENGESELLSCHAFT), 8 February 1990 (08.02.90), page 6, line 16 - line 31, claim 12	1
A	---	2-7
A	Patent Abstracts of Japan, abstract of JP,A, 6-155758 (SEIKO EPSON CORP), 3 June 1994 (03.06.94)	1-7
A	Patent Abstracts of Japan, abstract of JP,A, 7-148918 (CANON INC), 13 June 1995 (13.06.95)	1-7

 Further documents are listed in the continuation of Box C. See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT
Information on patent family members

01/10/97

International application No.
PCT/IB 97/00706

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9000974 A1	08/02/90	CA 1310596 A DE 8800462 U EP 0433280 A,B US 4934556 A US 5365312 A	24/11/92 25/02/88 26/06/91 19/06/90 15/11/94